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AUTHOR Ackoff, Russell L.
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ABSTRACT

Three fundamental educational issues which are usually ignored in favor of more trival operating problems are identified as follows: how can the educational process be redesigned to focus on the learning, not teaching, process; how to avoid organizing education around rigid schedules and artifically quantified units of subject matter and instead promote development of a continuous desire to learn and an ability to do so; and how to design an educational system that individualizes each student, preserves his sense of self, and encourages creativity? The contribution of management scientists to these problems is suggested as replacing reactive designing by idealization. Idealization rotates planners and designers toward what one does, facilitates involvement of a large number of participants, and encourages the consciousness of self-imposed constraints, making it easier to remove them. Some of the possible solutions, contained in an idealized education system developed at an international conference of operational research societies, are summarily outlined in a learner-centered design for preschool through university levels. (Author/KSM)

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A MANAGEMENT SCIENTIST LOOKS AT EDUCATION AND EDUCATION LOOKS BACK

Russell L. Ackoff

Silberberg Professor of Systems Sciences
The Busch Center
The Wharton School
University of Pennsylvania
Philadelphia, Pennsylvania

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by

Russell L. Ackoff
University of Pennsylvania

ABSTRACT

First, three fundamental educational issues which are usually ignored in favor of near trivial operating problems are identified. Second, a description is given of the way Management Scientists could contribute to the resolution or dissolution of these problems if they stopped accepting those given to them and insisted on working on the "right ones." Finally, a taste of the irreverence of the types of solutions proposed by atypical and irreverence Management Scientists is offered.

INTRODUCTION

It is hardly necessary to say to a group of scientists and educators that no single discipline - let alone an interdiscipline such as the Management Sciences - can be spoken for by any one of its practitioners. The Management Sciences are neither monolithic nor are they always called by this name. To some 'Management Science' is synonymous with 'Operations Research,' or the 'Policy, Organizational, or Decision Sciences,' to mention but a few. It is not surprising, therefore, that it is at least as hard to find a prototypical practitioner of the Management Sciences as it is to find a prototypical educator. Although I am involved in both activities the remarks that follow are made from a very personal point-of-view.

From where I view things educators, educational administrators, and educational researchers appear to be fiddling with schools while education burns. Our educational system as a whole and every part of it is being subjected to widespread criticism.* The indictments against it are too numerous even to list here. It is worth noting, however, that a growing number of serious and qualified evaluators find that the primary function of schools, even primary schools, is no longer educational. Schools have become institutionalized baby-sitters, publicly supported day-care centers, low-security sleep-out detention homes, and places for those between infancy and adulthood to grow up without bothering their parents or being bothered by them. Although the United States has a larger percentage of its population in school than any other

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* For example, see (10), (12), (13), (14), (15), and (21).

nation, it is the only developed nation in the world with a declining literacy rate. Little wonder that Ivan Illich (14) suggested "deschooling" society and that so many take his suggestion seriously.

The height of higher education has not kept it from being climbed over by its critics. It is charged with ineffectiveness, inefficiency, and irrelevance; with following rather than leading cultural change; with being more an apologist for the present and past than an inventor of the future; and with failing to respond to the critical needs both of the society of which it is a part and of the young who take part in it. Those involved in higher education tend to confuse growth with life; they forget that cemeteries grow continuously.

The failure of formal education, in my opinion, derives from two sources. The first is its failure to deal with the right problems, not its failure to solve the problems with which it deals. The second is the fact that education is not carried out by a system but by an antisystem - a deliberately noninteractive set of institutions each of which is carved up into equally noninteractive components.

Despite the need to face fundamental educational problems most Management Scientists working in this area accept less important problems posed by educators. As a result their efforts have been directed at making an ineffective system operate more efficiently. Efficiency, not effectiveness, has been at the focus of their attention.

Management Scientists have been actively engaged for many years in assisting educational administrators in solving the types of problems with which they normally occupy themselves; for example, budgeting to and within schools; forecasting,

allocating, and scheduling facilities, faculty, and students; trading-off between class size, teaching load, and required contact hours; purchasing supplies; supplying and staffing service, administrative, and academic units; locating new facilities and determining what capacity they should have; and developing automated information and budgetary control systems.*

The outputs of such studies have not been insignificant. They have reduced waste of valuable human and material resources, and they have led to greater efficiency of operations. There is nothing wrong with what has been done but there is with what is not being done; the sins are of omission, not commission. My critique, therefore, is directed at the Management Sciences as much as it is to education.

My remarks fall into three parts. I will identify a few general educational problems which I believe should be but are not dealt with adequately. I will say a few words about how the Management Sciences could contribute to their solution. And finally, I will try to give you a taste of the types of solutions proposed by atypical Management Scientists.

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* An extensive bibliography and abstracts of such studies as these and many others are available. See (18) and International Abstracts in Operations Research published for the International Federation of Operational Research Societies.

SOME PROBLEMS OF EDUCATION

Understanding of the failure of formal education must begin with recognition of the fact that it is less effective in general than informal education. Evidence of this is plentiful. Children learn their first language at home and on the streets more easily than they learn a second at school. Most adults forget much more of what they were taught in school than of what they learned out of them. Most of the knowledge that adults use at work and play they learned at work and play. This is even true for teachers. They learn more about the subjects they teach by teaching them than by being taught about them. University professors are not exceptions; many of them are occupied with subjects they were never taught. None of the subjects I have taught since 1951 even existed when I was a student.

Informal learning takes place without formal teaching. Schools, however, are committed to teaching, not learning, because teaching, unlike learning, can be industrialized and mechanized; it is easier to control, budget, schedule, observe, and measure. Educators appear to want what they can measure rather than try to measure what they want. Teaching is an input to education, not an output, but our educational institutions act as though an ounce of teaching is worth at least a pound of learning. Nothing could be further from the truth.

Therefore, the first question about education to which I believe educators and Management Scientists should address themselves is this: How can the educational process and the institutions in which it is embedded be redesigned so that they are focussed on, and organized about, the learning, not the teaching, process?

Informal education is not organized into subjects, courses, semesters, curricula, or other discrete units. A child's learning a language, for example, is not separated from its learning many other subjects. Reading and writing, geography and history, economics and arithmetic, and philosophy and science may be taught separately, but they cannot be learned separately.

Subjects and disciplines are categories of a filing system, not of Nature. Our knowledge can be filed in many different ways. No way is more correct than another, only more useful; but no one filing system is the most useful for all purposes and none is organized in the way the reality it reflects is. More important is the fact that although it may be necessary to take knowledge apart in order to file or teach it, it is also necessary to reassemble it in order to use it. Formal education, like Humpty Dumpty, had a great fall but only a few educators, like all the king's men, are trying to put it together again.

What one learns informally is learned without benefit of either categories or certification by examination. This, one might argue, is only true for what one wants to learn, but schools must teach the young what they should learn regardless of whether they want to learn it or not. This argument is not only incorrect; it is also inhumane. Students should be motivated to learn whatever they ought to learn but never be forced to learn anything. To do so is to take the fun out of it and this is much more serious than is the failure to learn any particular subject. The separation of work, play, and learning - a consequence of the Industrial Revolution in education - was, in my opinion, a major cultural catastrophe.

Furthermore, educators do not know what the student of today will need to know tomorrow. Most of it is not yet known. This is even true in professional schools. In a report to the Carnegie Foundation, W. G. Ireson (15) noted that sixty per cent of graduate engineers leave their profession within ten to fifteen years after graduation. Dael Wolfle (23) noted in Science that twenty per cent of American doctorates leave their fields within five years and thirty-five per cent within fifteen. And these trends are accelerating.

Therefore, the second question is: How avoid organizing education around rigidly scheduled, preselected, artificially quantized units of arbitrarily bounded subject matter, and, on the contrary, how promote development of both a continuous desire to learn and an ability to do so?

Even when fine-grained filters are used to select students for admission to a school, those selected vary widely in ability, interests, and knowledge. Therefore, the same input to different students does not produce the same outputs. Schools based on an industrialized model ignore or minimize the differences between students and thus require them to adapt to the educational process rather than the converse. The process should adapt to them. The individuality and creativity of the young should be preserved at all costs.

The American Anthropologist Jules Henry asked what would happen "If all through school the young were provoked to question the Ten Commandments, the sanctity of revealed religion, the foundations of patriotism, the profit motive, the two-party system, the laws of incest, and so on ....." (8, p. 288). Dr. Ronald Laing, the eminent

British psychiatrist, replied "... there would be such creativity that society would not know where to turn" (16, p. 71). Aye, here's the rub: society does not want to turn. A system that does not want to turn is more concerned with precluding disruptive inquiry than with developing the ability to inquire.

Therefore, the third and final question is: How can we design an educational system that individualizes each student, that preserves his sense of self, and that encourages creativity rather than conformity?

SOME METHODOLOGICAL OBSERVATIONS

We do not have answers to such basic educational questions as I have raised. Nor are they to be found if by "answer" we mean something that disposes of a question once and for all. Social systems, their institutions and their environments change continuously. What solves an educational problem at one time or place does not necessarily do so at others. Therefore, we need an educational system that, like students in it, can learn and adapt quickly and efficiently. Management Scientists know enough about adaptive-learning systems to know that they cannot rely on experience to teach them. Experience is too slow, too ambiguous, and too often wrong. It must be replaced by systematic and systemic experimentation.

Furthermore, such questions as I have raised are not independent of each other; hence, their solution should not be. The problems of education form a system even if education doesn't; their solutions should also. By decomposing educational problems we have obtained solutions to the parts that aggregate into what might be called an

"unwholly mess." Messes cannot be cleared up by problem solving; they require redesign of the relevant system and effective long-range planning for it. It is here that the Management Sciences can make a major contribution.

A number of Management Scientists - but far from the majority - realize that planning must replace most problem solving. The art and science of planning are developing rapidly. The design of problem-solving and planning systems is a natural extension of the work of the Management Scientist. A still further extension, equally as "natural," is the redesign of the system being planned for so that many of the problems with which it is engaged do not arise, and so that its overall effectiveness, not merely its efficiency, is significantly increased.*

When the redesign of one part of a system is undertaken independently of the redesign of the other parts, the range of alternatives which are considered to be feasible is severely limited. For example, the variety of possible changes in high schools which come to mind when we assume that no other part of the educational system is to be changed, is much more constrained that it would be if we were redesigning the entire system.

There are significant benefits to be derived from considering the redesign of education as a whole. By considering combinations of changes in the parts, larger potential effects on the whole can be brought about. New possibilities are uncovered for both the parts and the whole. The focus is appropriately changed: the characteristics of the whole are not viewed as resultants of the characteristics of the parts; rather the

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* For discussions of system planning and design see (2), (3), (4), (5), (6), (7), (9), (11), (12), (19), and (20). For an extensive bibliography on planning see (22).

characteristics of the parts are derived from desirable characteristics of the whole.

But even designs of and plans for a system as a whole can be severely constrained by restrictions that are perceived or assumed to exist by designers and planners. Most constraints are self-imposed. These can be removed by engaging in an idealized redesign of a system. This is a redesign "from scratch," with all constraints removed other than those of technological feasibility. In redesign of the educational system one would not assume, for example, direct transfer of the content of one mind to another without communication of observable symbols. Such constraints do not preclude contemplation of technological innovation but they restrict it to what is believed to be possible. On the other hand, all consideration of financial or political feasibility is removed. Therefore, an idealized redesign is an explicit formulation of the designers' conception of the system they would create if they were free to create any system they wanted.

Most system redesign and planning is reactive - preoccupied with identifying and removing deficiencies in the past performance of system components. Reactive planning and design moves from what one does not want rather than towards what one does. It is like driving a train from its caboose. One who walks into the future facing the past has no control over where he is going. Idealization rotates planners and designers from a retrospective to a prospective posture. It also does the following three things.

First, it facilitates involvement of a large number of those who participate and hold a stake in the relevant system. Because idealization focusses on long-range

objectives and ultimate values agreement tends to emerge from apparently antagonistic participants in the system and others affected by its behavior. Most disagreements arise from consideration of means, not ends. Awareness of consensus on ends usually brings about cooperation with respect to means among those who would not otherwise be so inclined. Because the idealization process forces those engaged in it to make explicit their conception of the system's objectives, their conception is opened to examination by others. This facilitates progressive reformulation of objectives and development of consensus on them.

Secondly, idealization leads those engaged in it to become conscious of self-imposed constraints and hence makes it easier to remove them. It also forces re-examination of externally imposed constraints that are usually accepted passively and thus makes it possible to find ways of "getting around" them.

Finally, idealization reveals that system designs all of whose elements appear to be infeasible when considered separately, are either feasible or nearly so when considered as a whole. Therefore, it leads to subsequent design and planning that is not preoccupied with doing what appears to be possible, but with making possible what initially appears to be impossible.

For example, in the recently completed idealized design of Paris carried out under the supervision of my colleague, Professor Hasan Ozbekhan, representatives of each of the many political parties in France participated and came to agreement. The design which they approved has been submitted to the French public and is now being widely discussed. The cabinet of France and the representative body of stake-

holders who served as reviewers agreed on the desirability of making Paris a global, rather than a French, city. Having agreed on this objective they subsequently accepted means that they would have rejected summarily had they been proposed separately or out of this context. For example, they have agreed to move the capital of France from Paris and to make Paris an open and multilingual city.

No formulation of an ideal should be taken as final, as an absolute. It should be revised as we approach and get a better view of it. But equipped with an explicit ideal, however tentative, we can begin to invent efficient and effective ways of making it real.*

SOME ASPECTS OF POSSIBLE SOLUTIONS

At the Sixth Conference of the International Federation of Operational Resarch Societies held in Dublin in August of 1972, a Workshop on Education spent several days developing an idealized design of an educational system. Lack of time prevented completion of the effort, but the group did produce a report of some of the characteristics on which it had reached agreement. These were as follows.

A child or his parents should be able to apply for admission to any and every school in a system. Selection among applicants should be made at random. Each school should receive tuition from the government for each student attending.

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* For an idealized design of a university see (1).

This should be the only governmental support of any school. Government should provide free transportation to any school in the system. These measures would create a competitive educational market place.

Teachers should stop formal teaching unless requested to do so by students. They should primarily serve as resources to be used by students as they see fit in their efforts to learn, to learn how to learn, and to find good reasons for wanting to do so.

More time in early school should be spent on learning how to convert what is learned out of school into information, knowledge, and understanding than in obtaining substantive inputs. Currently, the child is left on its own to convert raw material obtained in and out of school into something useful. Put another way, the emphasis of school should be on processing what is learned rather than on learning things that need to be processed.

In at least some of what is now the preschool years, parent and child should attend school together. Reading and writing, like the first language, should be learned before entering school. Schools should provide a wide variety of subjects and means of access to them. The student should be free to choose from these but he should have available continuing advice to assist him in these choices.

Students should not be assigned and confined to homogeneous age or attainment groups, but should be a part of largely self-organizing heterogeneous student groups in which the opportunity to learn from each other is maximized and the need

to learn from a teacher is minimized.

Every so-called teacher at every level of the educational system should be required to be a student at some higher level of the system. This implies that there be no highest level of education.

Now for a few observations about universities.

Universities should have no entrance or exit requirements and confer no degrees. Students should come and go as they please. They should not be examined on what they have learned unless they want to be. Examinations should be conducted so as to maximize students' learning, not unlearning, and not so as to minimize the task of grading. Records of examinations should go into a file to which only the student has access. Dissemination of its content within or without the university should be completely under the student's control. Failures should not be recorded, only accomplishments. Qualifications of students should be determined outside the university. Requalification, even of professionals, should be frequent to encourage keeping up with developments and to encourage continuous use of the university.

Selection of faculty members should be controlled by other faculty members, but their retention should depend on students as well as faculty. Faculty ranks should be eliminated because the quest for promotion currently dominates the quest for knowledge.

Finally, there must be a more effective way than tenure of protecting academic freedom and a less effective way of protecting academic incompetence.

The workshop's conclusions were considered by its members to be tentative and preliminary. We need many more, and more comprehensive and systematic, idealized educational design efforts. These should be made by educators and management scientists working together. Unfortunately, efforts and implementation of their output hardly seems immanent.

Meanwhile, there is no need to ask for whom the school bell tolls.

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